DEPARTMENT OF THE ARMY
Corps of Engineers, Northwestern Division
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CENWD-MT-E
Regulation
No. 1110-1-2

31 March 2003

Engineering and Design
CONSTRUCTION AND/OR DEVELOPMENT IN SPILLWAYS

History. This regulation supersedes the former MRD "Policy Statement Regarding Construction and/or Development in Emergency Spillways", dated 16 May 1991.

Summary. This regulation establishes policy on district coordination to assure that modifications to spillways at Northwestern Division (NWD) owned dams do not compromise the ability of the project to function as originally designed and intended to meet the Base Safety Condition. This regulation applies to all NWD operating projects identified as Corps-owned Federal dams in the FEMA National Inventory of Dams (NID) database.

1. PURPOSE. The purpose of this regulation is to ensure no construction, development or deferred maintenance that compromises the ability of the project to function as originally designed and intended will be allowed in the spillway. The spillway consists of its entrance channel, the crest section, and the exit channel.

2. APPLICABILITY. This regulation is applicable to all districts in the Northwestern Division.

3. REFERENCES.

a. Federal Guidelines for Dam Safety, dated June 25, 1979.

b. Water Resource Development Act of 1986, PL 99-662.

c. The Dam Safety and Security Act of 2002 (PL 107-310).

d. ER 1110-2-1155, Dam Safety Assurance Program, dated 12 September 1997.

e. ER 1110-2-1156, Dam Safety – Organization, Responsibilities, and Activities, dated 31 July 1992.

f. ER 1110-2-1451, Acquistion of Lands Downstream from Spillways for Hydrologic Safety Purposes, dated 10 August 1978.

g. EM 1110-2-1420, Hydrologic Engineering Requirements for Reservoirs, dated 31 October 1997.

h. EM 1110-2-1603, Hydraulic Design of Spillways, dated 16 January 1990.

i. NWDR 1110-1-3, Modifications at Existing Corps Owned Civil Works Projects, dated 31 March 2003.

4. RESPONSIBILITIES.

a. The district's Dam Safety Officer is responsible for assuring that spillways at Corps-owned dams can convey design floods to the watercourse downstream of the dam without jeopardizing the structural integrity of the dam or reducing the level of protection authorized for a specific dam project. The District Dam Safety Officer is the approval authority for any plan to test and construct modifications within a spillway.

b. The District's Dam Safety Committee is responsible for reviewing evaluation reports that conclude that either existing or proposed future conditions do not meet original spillway design criteria. The District Dam Safety Committee shall make recommendations to the District Dam Safety Officer regarding appropriate response actions. The District Dam Safety Committee must approve concept level designs that are forwarded to the Committee, before a proposal proceeds to a detailed design phase. Written minutes from the District Dam Safety Committee meeting, signed by the District Dam Safety Officer, is adequate documentation of approval.

c. District personnel, including Managers at Operating Projects and In-house Project Managers involved with proposals impacting spillways, shall inform the District Dam Safety Officer of any existing conditions that vary from original design and of any proposed development and construction within spillways. Project proposals shall include funding for an engineering evaluation if conditions differ from original design. No construction will be allowed without the endorsement of the Dam Safety Committee and written approval of the District Dam Safety Officer.

d. The District's geotechnical, structural, and hydraulic engineering technical experts shall evaluate any existing conditions that vary from original design and proposals for future modifications to spillways at Corps-owned projects. The technical experts shall report conclusions regarding potential impacts to the Project Manager, District Dam Safety Committee, and Operations Manager.

5. POLICY. This policy is applicable to Corps of Engineers owned projects modified by either USACE or external customers within the boundaries of the Northwestern Division.

Spillways are an integral feature of all Corps dams, the integrity of which must be preserved through out the project life to ensure the safety of the project. It is essential, therefore, that all elements of the district dam safety team work in concert to ensure that actions are not permitted which compromise the overall function and capability of this critical feature over the project life.

a. The basic purpose of the spillway is to provide a means of controlling the flow and providing conveyance from reservoir to tailwater for all flood discharges up to the spillway design flood. The spillway can be used to regulate floodwater solely, or in combination with flood-control sluices or outlet works. A terminal structure to provide energy dissipation may be provided at the downstream end of the spillway.

b. For this regulation, the spillway is defined as the area necessary to allow safe passage of flood flows around the dam. The spillway entrance is the area leading from the reservoir to the upstream end of the spillway channel. The spillway exit is the area between the downstream end of the spillway channel and the flood plain of the natural channel downstream of the dam. The spillway crest is the designed point of control for spillway releases and is set at an elevation where spillway flow must begin to ensure that the dam will not be overtopped. The spillway crest lies within the spillway channel and sometimes is a separate structure constructed on rock, concrete, or sheet piling. In many projects, the spillway crest is merely the highest elevation in the spillway channel bottom profile, usually located near the spillway entrance.

c. Dam failures have occurred due to an inability to safely pass flood flows. Failures occur by overtopping of the dam or by progressive erosion of the spillway and partial breaching. Factor that influence erosion in spillways include: flow duration and rate; channel gradient and discontinuities, especially knickpoints; channel configuration; and the underlying geomaterials. The erosiveness of these materials can range from highly erosion resistant sound, unweathered rock to very erosive weathered, layered or jointed rock or soil.

d. Overtopping of a dam occurs when the water level in the reservoir exceeds the height of the dam. A 1998 study by Foster, Fell, and Spannagle of 124 dam failures in the United States attributed 47% of the failures to overtopping. Overtopping may not necessarily result in a failure. Failure depends on the type, composition, and condition of the dam and the depth and duration of flow over the dam. Embankment dams are very susceptible to failure when overtopped because of potential erosion that can lead to a breach and failure of the dam. During overtopping, the foundation and abutments of concrete dams can also be eroded, leading to a loss of support and failure from sliding or overturning.

e. Flows through unlined spillways adjacent to dams can result in erosion that progresses to the dam and threatens it. Erosion can also cause headcutting that progresses

toward the spillway crest and eventually leads to a breach. Discontinuities in slope, non-uniform vegetation or bed materials, and concentrated flow areas can start headcuts and accelerate the erosion process. Erosion that occurs due to flow concentrations can start where roads or trails are devoid of vegetation or have ruts that run parallel to the spillway flow. A varied mix of earth materials, unlevel cross sections, uneven stands of vegetation, and obstructions can cause turbulent, concentrated flow conditions that start gullies than can widen and migrate upstream to breach the spillway crest. Runoff brought into a spillway channel by a side inlet may also disrupt the desirable uniform flow pattern and increase erosion in the channel.

6. GUIDELINES. The following guidelines will be used in evaluating any impacts of development in or near a spillway.

a. Spillway Capacity and Obstructions. The spillway is designed to make releases from the reservoir pool to prevent a design flood event from overtopping the dam. In order for the system to function as designed, it is critical that a specified spillway discharge capacity be maintained for a given reservoir elevation. Any fixture which causes an obstruction that reduces the capacity will not be permitted in the spillway channel, entrance, or exit. Fixtures that would normally be found unacceptable include material stockpiles, fences, posts, poles, grills, buildings and other structures, and earth fill such as roads. Additionally, trees and brush will not be allowed in the spillway.

b. Spillway Erosion. Many spillway channels are unlined and are expected to experience some erosion during a spillway discharge. It is imperative that the rate of erosion be controlled and that measures which induce or aggravate erosion in the spillway be prohibited. This is especially important for those spillways founded in more erosion susceptible materials (e.g. highly weathered rock or soils and those with a relatively frequent use). The preferred design philosophy for many limited service spillways is that erosion during any one flood event not result in a catastrophic release of the reservoir. Any damage must then be repaired prior to the next flood event.

(1) The following factors may cause flow concentrations that can accelerate erosion, even at low discharges:

(a) Any fixtures located in the spillway channel may create turbulence and local flow concentrations that induce local scour;

(b) Grading for such features as drainage ditches, roads, trails, and playing fields, all result in spillway channel cross sections with bottoms that are not uniformly horizontal and tend to concentrate the flows in the low portions of the cross section and induce scour;

(c) Flow concentrations near the downstream end of a mildly sloping spillway channel that terminates into a steep spillway exit channel. These concentrations are especially critical because of the head-cutting that progresses upstream to the spillway crest, and possible spillway failure. Therefore, grading modifications or changes in vegetation cover in the spillway channel or exit that induce turbulence or encourage flow concentrations will not be permitted. Modifications that would normally be found unacceptable include grading for the drainage of playing fields, placement of roads, parking lots, trains, and drainage ditches; placement of rock stockpiles or fill material; activities that disturb the vegetation cover; and construction of fences, buildings, and other structures.

c. Physical Testing within Spillways. Physical testing may be required to support the evaluation and design of proposed spillway modifications. Care must be taken in the selection and placement of testing apparatus, to preclude temporary obstructions. To the extent practicable, equipment should be removable to provide for flood releases. Testing procedures must be thoroughly documented, endorsed by the District dam safety technical experts, and approved by the District Dam Safety Officer.

d. Future development. The development of certain facilities which initially may not compromise dam safety may lead to the development of other facilities which affect dam safety. Therefore, all future planned construction and/or development should be presented as part of the review process, so that the total impact of all phases may be evaluated.

e. Evaluation of Safety. When reviewing proposed construction and/or development, the current technical guidance and expert engineering judgement will be employed to assess impacts to spillway operations and develop recommendations.

(1) All phases of design, construction, and operation of dam and reservoir projects will ensure adequate safety to protect downstream areas against possible effects of partial breaching failure.

(2) Although freeboard allowance provide some factor of safety against unexpectedly severe reservoir levels and fluctuations, freeboard allowances are not considered as substitutes for prudent engineering analysis.

FOR THE COMMANDER:

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